Guidelines for Using Digital Photos as Fish Vouchers

for

Pennsylvania Fishes

Dr. Jay R. Stauffer, John Karish, and Timothy D. Stecko

The Pennsylvania State University and National Park Service

March, 2001

INDEX

	Page
Introduction	**1**
Choosing the Right Camera	**2**
Color Photographs	2
Pixel Density	3
Macro Capability	3
Built-in or External Flash	3
Summary of Recommendations	4
Photographing Specimens	**5**
Field of view	5
Size referencing	6
Identification of individuals	6
Saving files for voucher purposes	6
File format and compression	5
File names	6
Summary of Recommendations	6
Rules for Capturing Voucher Images of Fishes	**7**
Description of photographic views	8
Method 1	10
Method 2	13

Introduction

It may not always be desirable to harvest all fishes collected while conducting aquatic sampling and/or inventories. Species of special concern must often be released on site. The use of hazardous chemicals for tissue fixation and preservation can be prohibitive, and the storage of preserved or live specimens may require resources that are not available or could be put to better use. The use of digital photographs to document which species have been collected can be a suitable method to voucher fish species, addressing the concerns previously mentioned. With the exception of the initial cost of purchasing a digital camera and computer, the costs of digitally vouchering fishes is a relatively economic method of vouchering fish species: there are no film development fees, reproduction of images is essentially without cost, and storage costs of images is negligible.

The guidelines within this document explain how to use digital photographs to accurately voucher fish specimens. Although it may not be possible to identify all fish specimens from digital photographs taken in the field, these guidelines will help with the identification of most fishes collected, thus permitting their release back to the waters from which they were collected. The fish specimens likely to be the most difficult to identify from digital photos are immature fishes of all species and even the adults of some minnow species, particularly in the genus *Notropis*. If the identification of such fishes is necessary, these specimens must be identified on site or properly preserved for later identification.

Choosing the Right Camera

Digital cameras come in many different styles with varying functionality. It is critical that the appropriate camera be selected for use in vouchering fishes with digital photographs. Fortunately, there are many models that meet the requirements for digital photo vouchers. Several specifications that should be met when selecting a camera: 1) color photographs, 2) high pixel density CCD or CMOS, 3) macro capability, and 4) built-in or external flash.

Color Photographs

The color capabilities of digital cameras are often described in terms of color depth. Color depth is the number of colors or shades of which an image is comprised. Color depth is referred to in terms of bits. Camera users will see ratings such as 8-bit, 16-bit, 24-bit, and 32-bit. The bit number refers to the number of binary digits used to code for color or tone. An 8-bit coding scheme uses 8 digits to code for color. Each of the 8 digits can assume a value of a 0 or 1. Thus, a one bit image can have 2 colors or tones, typically black and white. Eight bit images can contain a maximum of 256 colors or shades (2^8=256). This depth of color is insufficient for voucher images. Only at 16-bit or greater do digital images approach photo-realism, and thus better represent the coloration of the specimen. A 16-bit image has a maximum of 65,536 colors (2^{16}=65,536).

The color of the voucher specimens can be a powerful discriminating tool. Colors of fish vary by species, time of year, age, sex, and even geographic location. Digital image vouchers should be 16-bit color images at a minimum, preferably 24-bit or greater.

Pixel Density

A pixel is the smallest graphical element of a digital image. Each pixel represents a single item of graphical information about the object being photographed. The more pixels comprising an image, the more information about the object you will have. Pixel densities of cameras are typically expressed in terms of horizontal and vertical resolutions. For example, the Olympus C-2500L digital camera has a 2.5 megapixels CCD. The camera claims maximum horizontal and vertical resolutions of 1712 pixels by 1368 pixels. Multiplying the maximum horizontal and vertical resolutions yields a value of 2.34 million (or mega) pixels, close to the 2.5 megapixels rated CCD. Obviously, not all of the CCD's 2.5 megapixels are used in the final image. But, this example does explain the basics of the pixel densities/CCD and image resolution relationship. It is important to have images with resolutions of at least 1024 pixels by 768 pixels, simply expressed as 1024X768. Larger images would provide more information upon which to base an identification. Factors such as camera specifications and available storage memory will limit the size of the digital image being captured. Each user must determine how large these images will be.

Macro Capability

The most difficult of fishes to identify are often the smallest ones. To identify such fish it is necessary to take large photos of these small specimens. To take photos of small objects the camera must be able to focus on objects that are very close to the lens. When selecting a camera for this use, choose one that is able to focus on images as close as 4 cm. Some macro features on digital cameras will allow even shorter focal distances, which can also be useful.

Built-in or External Flash

The use of a flash can serve two purposes, provide adequate lighting, and increase shutter speed. Proper lighting will highlight the specimen's natural colors, assisting in an accurate identification, and permit photography in low light conditions. The fast shutter speeds are critical when taking photos without the use of a tripod or some other device for stabilizing the camera. Even the most steady of grips can produce miniscule movements that can blur images. In full sunlight, shutter speeds are very fast and hand held shots can be exceptional. When light conditions are low, a flash will compensate for the lack of natural light, producing fast shutter speeds and crisp photos. If possible, use natural light by moving specimens from the shade to full sun.

Summary of Recommendations

A digital camera selected for the purpose of collecting digital images of fishes for voucher use should meet the following requirements. The camera should capture 16-bit color images at a minimum. Image resolutions should be no less than 1024X768 pixels. The camera should be capable of macro photography at distances of 4 cm or closer. A built-in or external flash should be available for use in low light conditions, such as cloudy days.

Photographing Specimens

Once a suitable camera has been selected, particular attention must be paid to a number of aspects of the image collection and handling process. When photographing the specimens you must make the most of the field of view and provide references for determining size and the identification of individuals. The handling of image files involves name selection, addition of voucher information to the image, and selection of file formats.

Field of view

As a rule, when taking voucher photos, it is best to fill as much of the field of view as possible with the subject (Figure 1). The macro option of your camera will be useful when photographing small fish or when photographing particular structures or areas of the specimen.

Figure 1. Photo A (*Rhinichthys atratulus*) depicts an improper use of the field of view. Photo B (*Rhinichthys atratulus*) shows a proper use of the field of view. Photo B is much more useful as a voucher photo.

Size referencing

The size of the specimen is important information to document. Size can be helpful in the identification process and assessing population characteristics, such as presence of breeding age individuals and health factors. It is therefore important to provide a means of estimating size for each specimen photographed. By simply including a tape measure, meter stick, or some calibrated device, size can be estimated from the photographs (Figure 2).

Figure 2. Image of *Catostomus catostomus* from Whites Creek, Somerset County, PA. The measuring tape in the upper portion of the image can be used to estimate the length of the specimen. Additionally, the tape can be used to assign a number to the individual for this collection site. Notice the mechanical pencil pointing to the number 3 on the measuring tape. A text label has also been added to the lower right part of the image. This text label provides information regarding species identity, specimen number, collection site, collecting institution, collection number, and date of collection.

Identification of individuals

Often more than one individual will need to be vouchered. Therefore it will be necessary to identify individuals from the digital images. Figure 2 demonstrates a simple method of assigning a number to each individual collected. If larger numbers of individuals are being vouchered, another system of numbering will likely be needed, as a tape measure will provide limited numbers and could become awkward to use. A simple method to overcome this problem would be to place a hand-held tally counter in the view to show the individual number.

Saving files for voucher purposes

File format and compression

In most cases, you will have two opportunities to select the file format and compression quality. The first opportunity will arise prior to taking the photos. Digital cameras allow the user to select different image qualities for image storage. The highest quality is typically an uncompressed format know as TIF. This format requires a great deal of space for storage and can seriously limit the number of images you can save on your camera's storage device. Even though this format will be the highest quality permitted by the camera, the gain in image quality is minimal compared to high or even medium-high quality compressed images and the loss of storage room for additional images makes it less desirable (Figure 3). Be aware that printed images may not be as clear as the digital originals. The originals can be zoomed in on to view greater detail

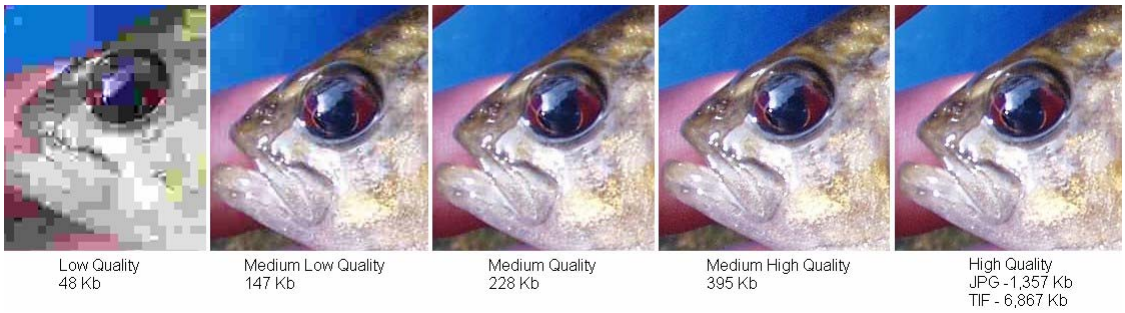


Figure 3. These five images represent different graphics file qualities as determined by the degree of compression of the jpeg file format. Also presented are the respective file sizes. Note that low quality results in a very small file size and poor image quality, while high quality results in a very larger file size and excellent image quality. A balance between file size and image quality must be found.

and are not compromised by the limitations of a printing device.

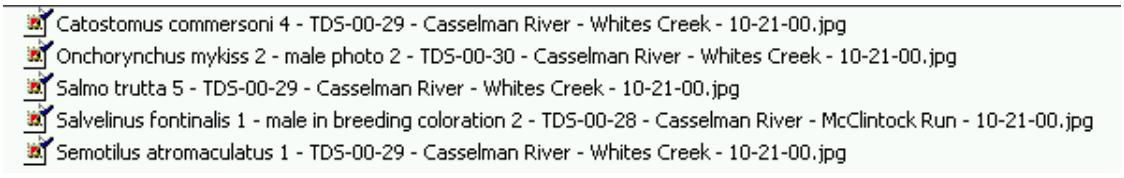
Cameras will usually allow for the storage of images in compressed jpeg format. The degree of compression or size of the captured image may also be selected. Always choose the physically largest image available, largest in terms of the horizontal and vertical resolution. Large images capture more detail and are better for identification.

Some of the more highly compressed image options can degrade the image somewhat (Figure 3). It is best to choose medium to high quality jpeg formats so as not to reduce image quality. After all, there is no point in making efforts to improve image quality by optimizing lighting and stabilizing the camera only to lose these gains by choosing a low image quality compression ratio.

File names

When the camera captures a digital image it will automatically assign a name to the file. The name is typically a combination of alpha and/or numeric characters that give no indication as to the file contents. Giving the file a descriptive name will help users identify the file without having to view the image. Furthermore, descriptive names can be very useful when searching hard drives, CD-ROMs, or other computer media for images of a particular content. For instance, if the file name contains the name of the species, one could find all voucher images for that species on a computer simply by searching filenames for the species name. The renaming of digital images is best done on a computer soon after the images are captured. Information that should be included in the file name is; species scientific name (if identified), individual identifying number, collection site description or collector's reference code, and date of capture. If the specimen has not been identified, this information can be added at the time of identification. The assignment of individual identifying numbers was described in a previous section. Review the section titled "Identification of individuals" for more information. A description of the collection site can also be useful. The collector's reference code is a code, catalogue number, or some marker that provides information about the sampling event that resulted in the collection and subsequent digital image vouchering of the specimen. For instance, the image in figure 2 has been tagged in the lower right corner with additional information. The line labeled "Coll. ID" contains a string of characters that refers to the collector's field code for a very specific collection. This is a unique code assigned by the investigator. No other collections by this investigator have this code. Referencing this code will provide access to more detailed information about the collection, the site, collection crew, sampling methods, etc. All investigators conducting fisheries sampling should keep copious field notes and assign such codes to their sampling efforts. Table 1 lists examples of file names that provide good descriptions of their contents.

Table 1. A list of file names. The name of each file provides useful descriptive information regarding the nature of the digital image file.



File names are useful in identifying file subject matter and in performing searches for files of particular content. However, file names can become corrupted, thus eliminating crucial information about the image. Corruption of file names, although not common, can be a problem when sharing files with long names between different computing platforms (i.e., Unix, Macintosh, Windows XX). To preserve the link between image and collection information, one must include this information as part of the image itself. The text in the lower right corner of the image in Figure 2 contains all the information necessary to determine the image's origins and content. Only if the image becomes corrupted will the voucher be rendered useless. There are a variety of methods to incorporate text into graphics. It is not necessary to use an expensive graphics software package for the addition of text. The user should familiarize his or her self with the various graphical software packages available. Almost all camera manufacturers will distribute software with the digital camera that is more than capable of this task.

Summary of Recommendations

To summarize the photography of voucher specimens the following must be given consideration. The specimen should occupy as much of the field of view as possible. A reference to allow the determination of the specimens size must be included in the view and a unique number should incorporated into the view to permit the identification of individual fishes. When saving files, the appropriate file format should be selected before the photo is taken and after the file has been named so as to identify the file's image subject matter. Additional descriptive text should be added to the image to allow the viewer to identify the source of the image and additional image references. If these steps are followed the image will make a suitable vouch image.

Rules for Capturing Voucher Images of Fishes

This section discusses the types of digital photographs that will be helpful in the identification of fish species. Specifically, the photographic viewing aspect for each fish family or type of fish will be discussed. Not all fishes can be identified from voucher images. Fortunately, with the following of the aforementioned guidelines and the application of a few simple rules, most fish species, particularly those of a threatened or endangered status, can be successfully identified from digital images.

Because it is likely that individuals taking the voucher photos will have varying degrees of fish identification experience, voucher photo instructions will be provided as two methods. Each method is based on the concept that species can be identified from digital images provided that the appropriate view or views are captured by the images. A description of the views used is provided below. Method one will provide generalized instructions directing the user to take photos of a particular aspect based on easily discernable features of the specimen. Method two will provide photo instructions for individuals capable of identifying fishes to family.

Description of photographic views

Every effort should be made to photograph the left side of the fish. This has been the conventional view, because much of the physical work done on preserved fishes is done on the right side, often damaging tissues and blemishing the specimen's appearance. If the left side is of poor quality, the right side may be used. Methods 1 and 2 make use of the following views.

Lateral View – Side view of specimen from tip of snout to the end of the tail.

Oral Disk – Applies to lampreys only. Clear view of mouth opening and teeth. Allowing lamprey to attach to a piece of glass or plexiglass can help expose oral disk.

Lateral closeup of head – Side view of head from tip of snout to beginning of pectoral fin.

Ventral view of head and jaw – Bottom view of head from tip of snout to the end of the gill covers.

Clear view of dorsal and caudal fins – Make sure the dorsal fin(s) and caudal fin are clearly visible. Both fins should be flared, exposing fin structure and pigmentation.

Ventral view of pelvic fins – Bottom view of pelvic fins. Must be able to count rays in fins.

Clear view of anal fin – Can be complete snout-to-tail lateral view of specimen. May need to manually flare anal fin to expose anal fin spines.

Method 1

This method can be applied with very little knowledge of fish identification, although a basic knowledge of fish anatomy is required. Field guides, such as The Peterson Field Guide Series "A Field Guide to Freshwater Fishes – North America North of Mexico" provide information concerning fish anatomy. Users of this method must follow the information in the order it is presented. When determining which view or views to photograph, start with row number one in the table below and progress sequentially until the proper view is determined.

	Features to look for	**Example Image**	**View to Photograph**
1)	Specimen is snake-like and lacks a boney jaw LAMPREYS		-(adults) lateral view & view of oral disk -(juveniles) keep specimen
2)	Specimen lacks or has few scales, has large head and mouth, two dorsal fins, no barbells present on chin, specimen usually < 15 cm SCULPINS		**best to keep specimen** -(all specimens) lateral view & ventral view of pelvic fins

	Features to look for	Example Image	View to Photograph
3)	Specimen has 2 dorsal fins that are separate or very narrowly joined. Three anal spines present, spine present on opercle TEMPERATE BASSES		-(all specimens) lateral view & clear view of anal fin
4)	Long snout, dorsal fin much closer to caudal fin than the head, forked tail PIKES		-(adults) lateral view & lateral closeup view of head -(juveniles<10 cm) keep all specimens or views same as adults

	Features to look for	Example Image	View to Photograph
5)	Specimen is scaleless, has chin barbells, has adipose fin which may be connected to caudal fin CATFISHES		- (all specimens) lateral view (clear view of dorsal & caudal fins) & ventral view of head & chin
6)	Body is scaled, does not have an adipose fin, has a single, separate dorsal fin, front of dorsal fin is about in the middle of the body or closer to the head, pelvic fins are about midway between pectoral fins and anal fin or closer to anal fin. SUCKERS & MINNOWS		- (adults) lateral view & ventral view of head & jaw – (juveniles) – same as adults or keep specimen
7)	ALL OTHER FISH		Lateral view

Method 2

Users of this method must be able to identify fish to family level. Below is a list of families and their respective photographic views.

Petromyzontidae (Lampreys) – (adults) lateral view & view of oral disk – (juveniles) keep specimen
Acipenseridae (Sturgeons) – lateral view
Polyodontidae (Paddlefish) – lateral view
Lepisosteidae (Gars) – lateral view
Amiidae (Bowfish) – lateral view
Anguillidae (Freshwater eels) – lateral view
Clupeidae (Herrings) – lateral view
Hiodontidae (Mooneyes) – lateral view
Salmonidae (Trouts) – lateral view
Osmeridae (Smelts) – lateral view
Umbridae (Mudminnows) – lateral view
Esocidae (Pikes) – (adults) lateral view– (juvenile < 25 cm) – lateral view & lateral closeup of head
Cyprinidae (Minnows) - (adults) – lateral view & ventral view of head and jaw – (juveniles) – same as adults or keep specimen
Catostomidae (Suckers) - (adults) – lateral view & ventral view of head and jaw – (juveniles) – same as adults or keep specimen
Ictaluridae (Bullhead Catfishes) – lateral view (clear view of dorsal and caudal fins) and ventral view of head and chin
Apherododeridae (Pirate Perch) – lateral view
Percopsidae (Troutperches) – lateral view
Gadidae (Codfishes) – lateral view
Fundulidae (Topminnows and Killifishes) – lateral view
Poeciliidae (Livebearers) – lateral view
Atherinidae (Silversides) – lateral view
Gasterosteidae(Sticklebacks) – lateral view
Cottidae (Sculpins) – lateral view, ventral photo of pelvic fins, best to keep specimen
Moronidae (Temperate Basses) – lateral view – flare anal fin
Centrarchidae (Sunfishes and Basses) – lateral view
Percidae (Perches) – lateral view
Sciaenidae (Drums) – lateral view
Gobiidae (Gobies) – lateral view